Abstract No. Sham0272

Infrared Imaging and Spectroscopic Studies of Hemochromatosis Liver and Diabetic Mice Kidney and Liver Tissues: Preliminary Observations

P. Kim, T. Sham, S. Chakrabarti, and P. Adams (U. of Western Ontario)

Beamline(s): U10B

Introduction: Hemochromatosis is a disease in which the body absorbs excessive amount of iron from the diet. Excess iron is deposited in the liver and this can eventually lead to cirrhosis of the liver and hepatocellular carcinoma. It is the most common genetic disease in Canada with a prevalence of 1 in 327 documented in a large population screening in London, Ontario. Hemochromatosis is an autosomal recessive condition in which a defective gene has been inherited from each parent. Over 90 % of patients have a mutated HFE gene. The exact role of the HFE protein in the pathogenesis of hemochromatosis is not completely understood [1]. The issue in the mice kidney and liver analysis is the expected increase of Cu metallothioleins in diabetic mice compared to normal mice based on one hypothesis [2].

Methods and Materials: We conducted a preliminary study at the U10B line in June 2002 to evaluate the feasibility of imaging with IR at a spatial resolution of several microns and micro-spectroscopy of tissue specimens as noted in the title. The beamline is equipped with a Nicolet Fourier Transform IR microscope. The desired region of interest of the specimen was first captured as an optical image followed by an IR scan pixel by pixel (10 micron pixel size). An FT IR spectrum was obtained for each and every pixel. A series of measurements on the tissue specimens with a thickness of 5, 10 and 15 μm has been made in the reflection mode.

Results: The results indicate that the 5-μ specimen is most suitable for these studies. Some of the results are shown in Fig.1. The upper panel shows the IR for a single pixel (10 μm x 10 μm). The optical image is also shown. It can be seen from results in Fig.1 that there is a clear distribution of lipid and protein functionalities for example in various areas of the liver tissue. The analysis of the IR spectra and the images is still being conducted. The results together with x-ray microprobe work on the same tissues at similar spatial resolution and corresponding optical images, will be studied in detail. It is shown that the distribution and chemical identity of liver Fe can be readily probed with x-ray microprobe [3,4]. It is hoped that the elemental and chemical sensitivity of x-microprobe combined with the IR technique which is sensitive to bio-functional groups such as proteins and lipids, will shed some light on the excessive accumulation of iron and copper in human hemochromastosis liver and diabetic mice kidney and liver tissues, respectively.

Acknowledgments: Research at the University of Western Ontario is supported by NSERC (Canada). IR experiments were conducted at the U10B beamline of NSLS which is supported by the US Department of Energy, Division of Materials Sciences and Division of Chemical Sciences, under Contract No. DE-AC02-98CH10886 and the Canadian Light Source. We thank Lisa Miller and Neb Marvinkovic for their technical advice and assistance.

References:

[1] C. C. Philpott, “Molecular Aspects of Iron Absorption: Insights into the role of HFE in Hemochromatosis,” Hepatology, **35**, 993.

[2] G. K. Andrews, “Regulations of Metallothionein Gene Expression by Oxidative Stress and Metal Ions,” Biochemical Pharmacology, **59**, 95.

[3] T. Sham, S. Chakrabarti and P. Adams, “X-ray Microprobe Synchrotron Analysis of Hemochromatosis Liver,” Hepatology, **34(4)** 161: Part 2 Suppl. S Oct 2001. Poster Presentation at the American Association for the Study of Liver Diseases Annual Meeting, Houston, TX, USA, 2001.

[4] T. Sham, P. Kim, H. Ngo, S. Chakrabati, and P. Adams, “Synchrotron X-ray and IR Imaging of Hemochromatosis Liver and Diabetic Mice Kidney Tissues: Preliminary Observations,” Poster to be presented at the Canadian Light Source Annual Users Meeting, Saskatchewan, SK, Canada, 2002.

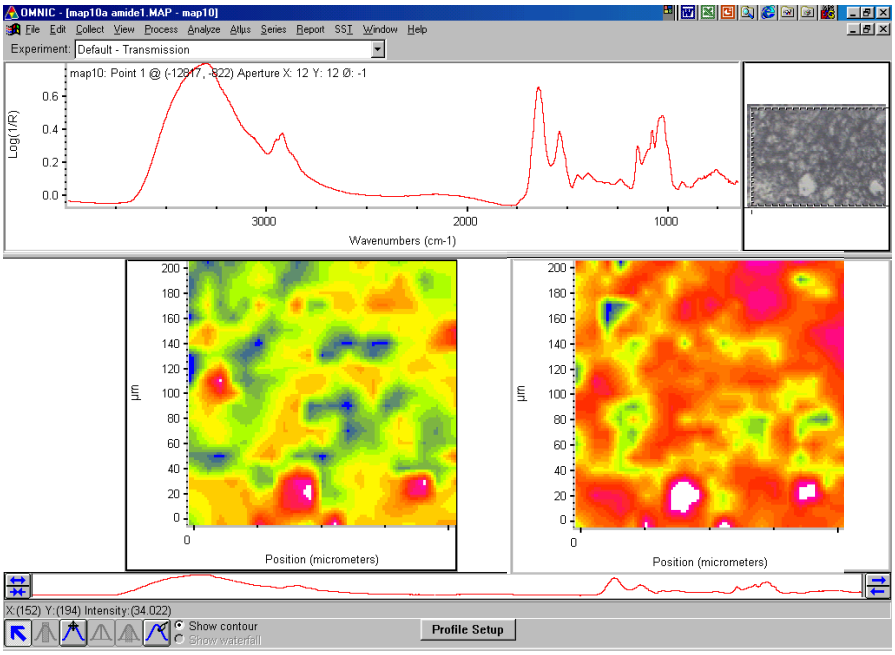

Figure 1. IR maps of protein (left) and lipid (right) of a hemochromatosis liver tissue.